First look at the incident pion data comparison

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Introduction

- Today, I would like to talk about:

  1) Bin coverage of different datasets

  2) First attempt to compare the data

- This is the first step to my comprehensive study of how to use the available datasets. My next steps include:

  1) The effect of the bin size

  2) The effect of the bin distortion when we move from integrated multiplicities to Feynman-x and pT

The center of momentum energy can be calculated with the mass of the incoming particle, the mass of the target nucleon involved in the collision and the incoming beam energy:

$$E^{CM} = \sqrt{m_{inc}^2 + m_{nucleon}^2 + 2E_{inc}m_{nucleon}}$$

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(*for Barton et al, 100 GeV*)
√((0.139)^2 + (0.938)^2 + 2*0.938*100)
Out[1]= 13.7295

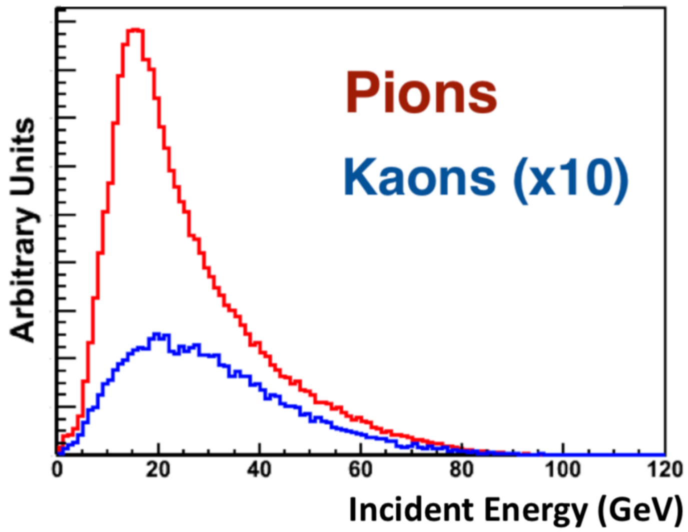
(*for NA61, 60 GeV*)
In[2]:= √((0.139)^2 + (0.938)^2 + 2*0.938*60)
Out[2]= 10.6517

(*for HARP, 12 GeV*)
In[3]:= √((0.139)^2 + (0.938)^2 + 2*0.938*12)
Out[3]= 4.83851
```

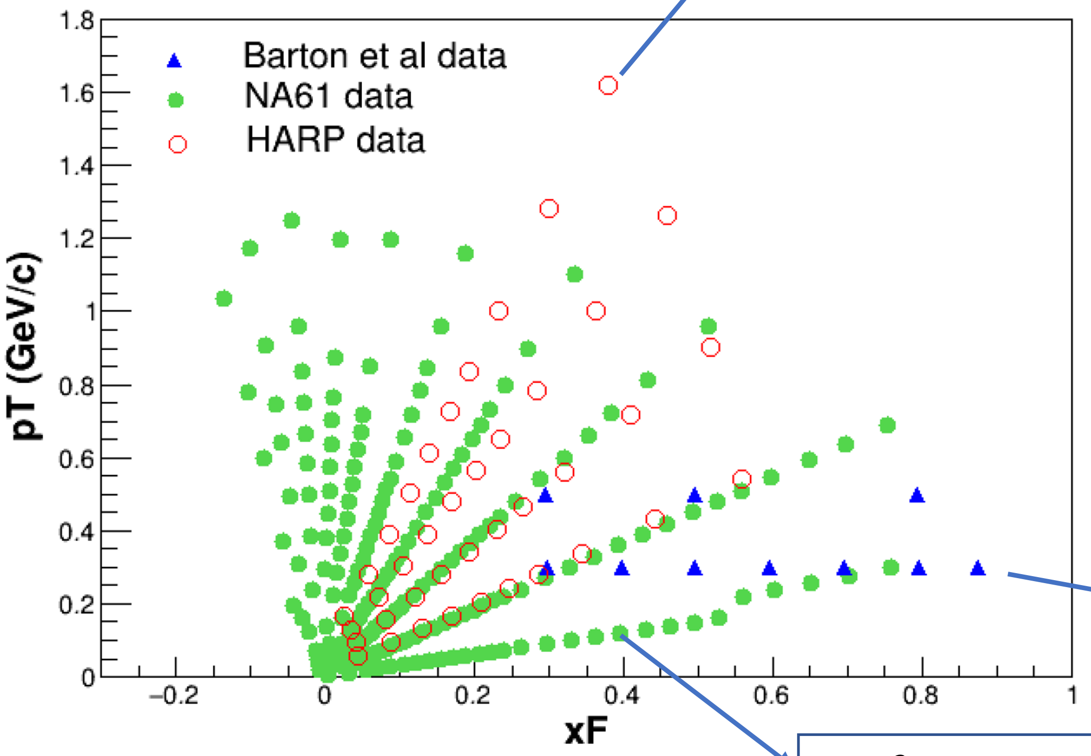
These values show the Ecm values for Barton, NA61 and HARP.

✓ Feynman-x works better for Ecm >10 GeV (the scaling)

Incident meson interaction in NuMI.



Data coverage:



$0.2 < \theta < 0.25$ rad
$0.5 < p < 8$ GeV/c

$0 < \theta < 10$ mrad
$0.4 < p < 33$ GeV/c

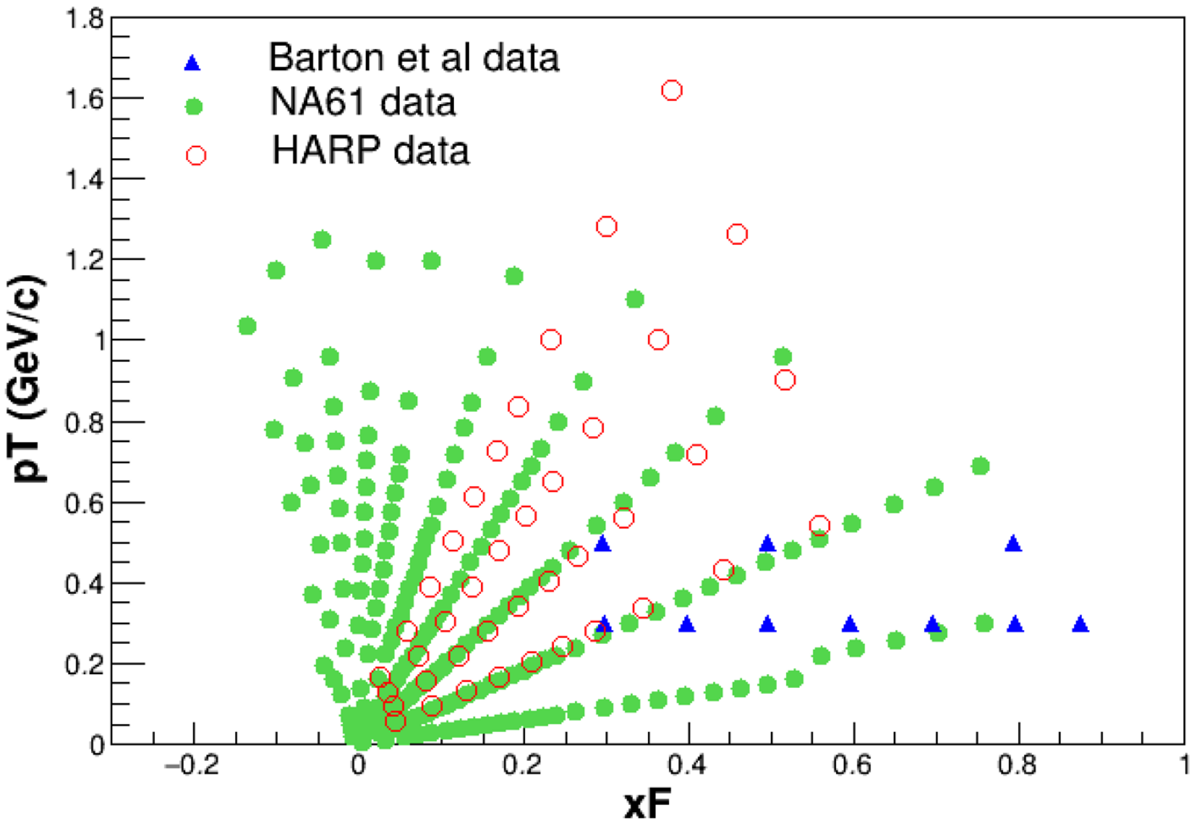
pT = 0.3 GeV/c
30 < ptot < 88 GeV/c

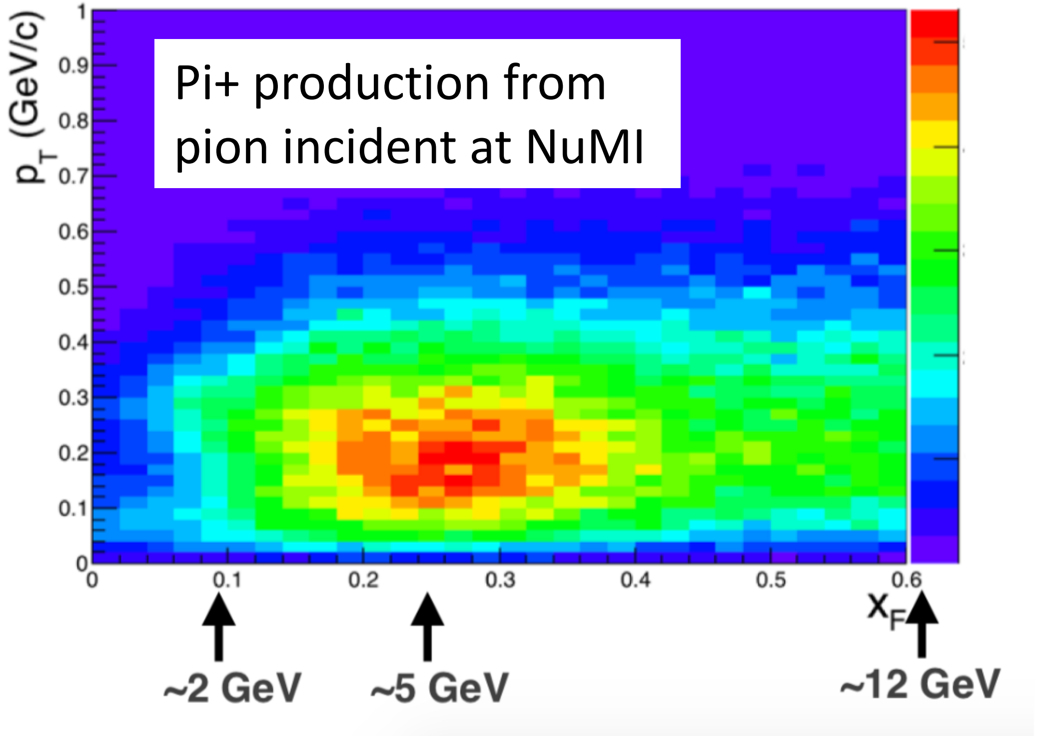
NA61: integrated multiplicities in [Pmin, Pmax] and [θmin, θmax]. I used the center of the bin convert to calculate Feynman-x and pT.

HARP: integrated cross-sections in [Pmin, Pmax] and [θmin, θmax]. I used the center of the bin convert to calculate Feynman-x and pT.

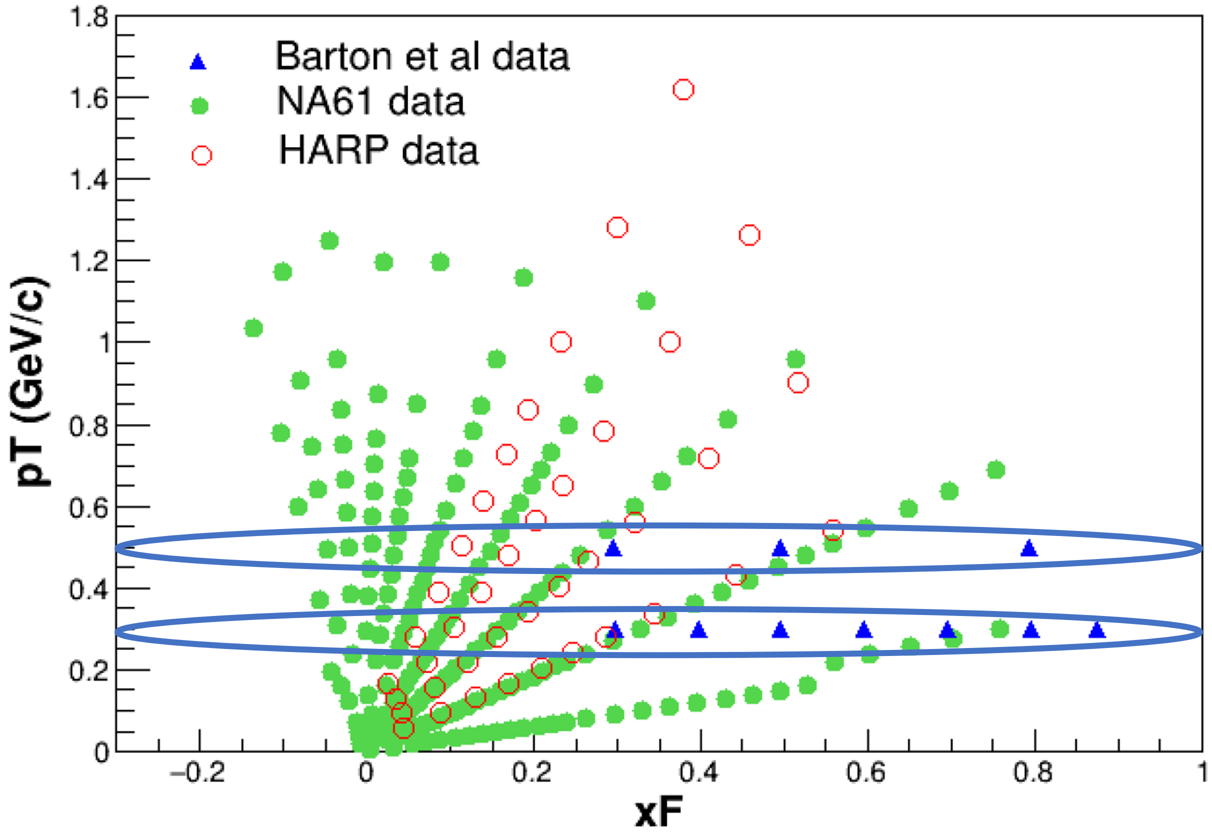
Barton: invariant cross sections in ptot and pT.
I calculated only Feynman-x.

Data coverage:

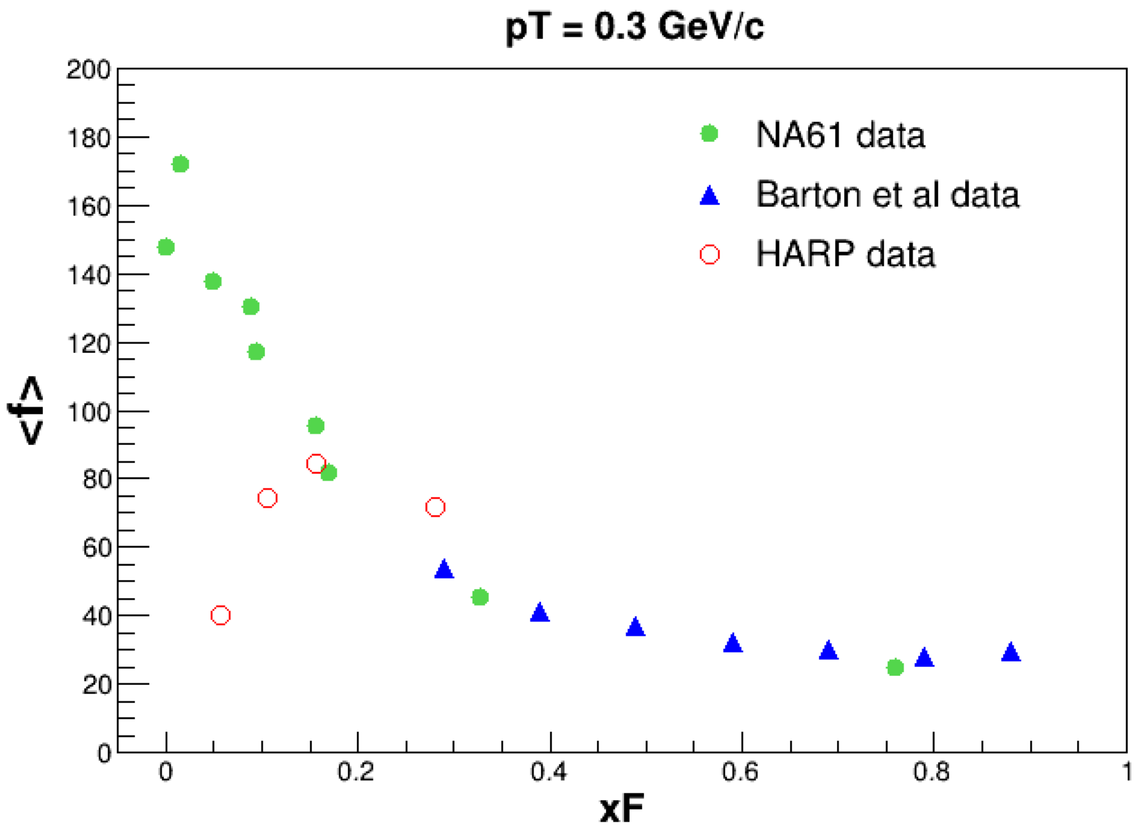




First attempt to compare data:



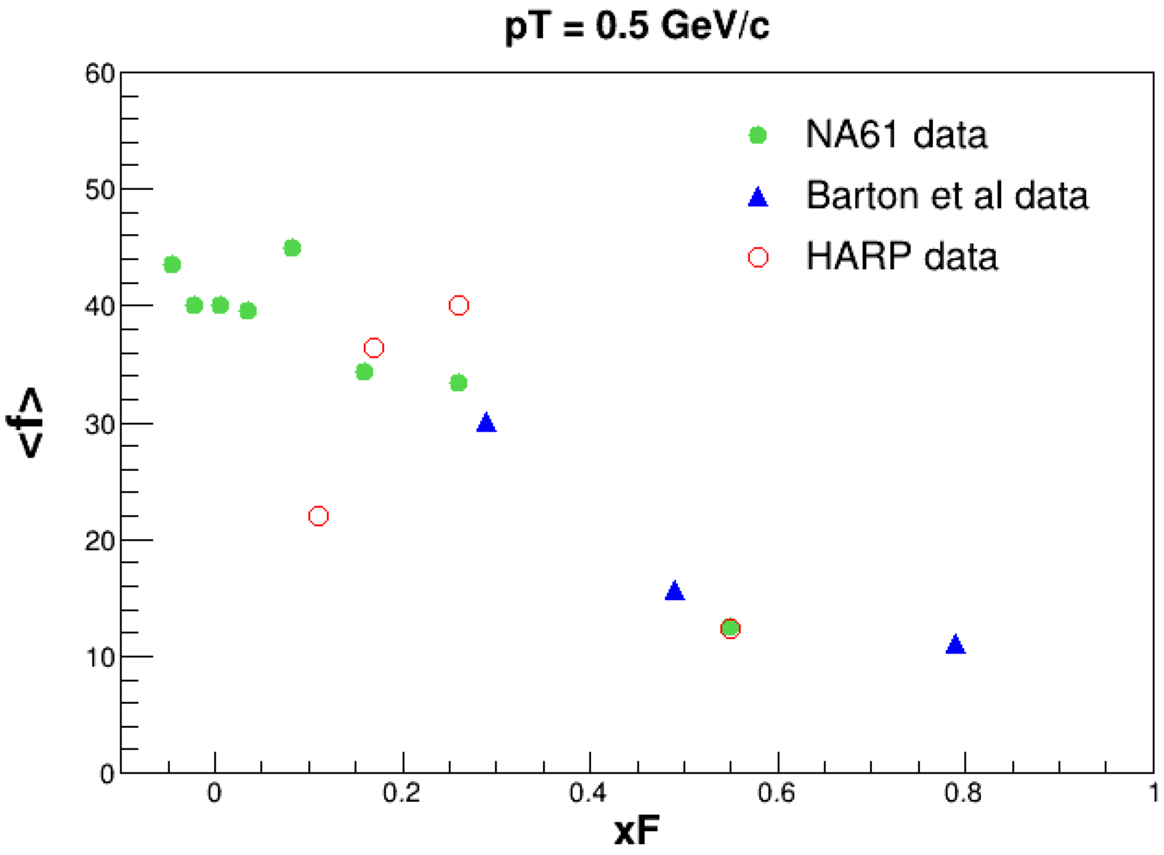
- ✓ I am going to calculate average invariant cross sections in the center of HARP and NA61 bin.
- ✓ I am going to use data point close to pT=0.3 and pT=0.5 GeV/c.
- ✓ I am not considering data uncertainty yet.



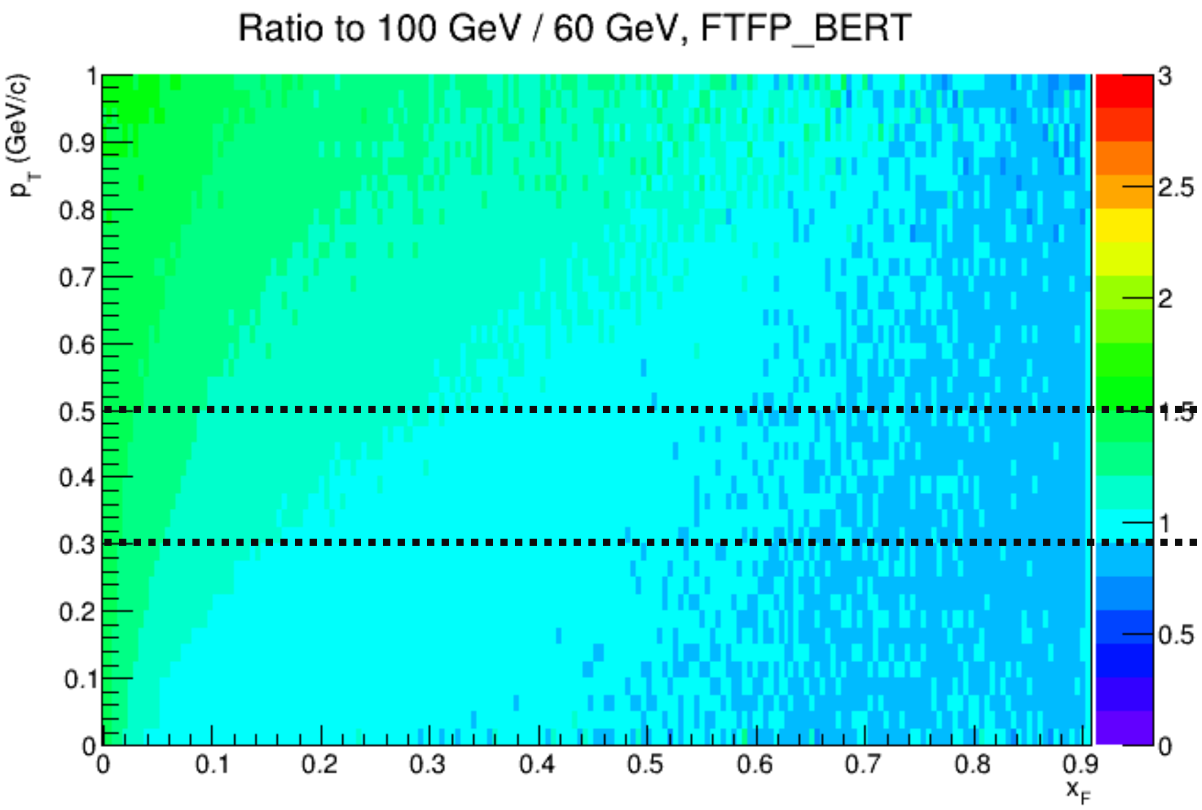
✓ Average invariant cross sections in NA61 and HARP.

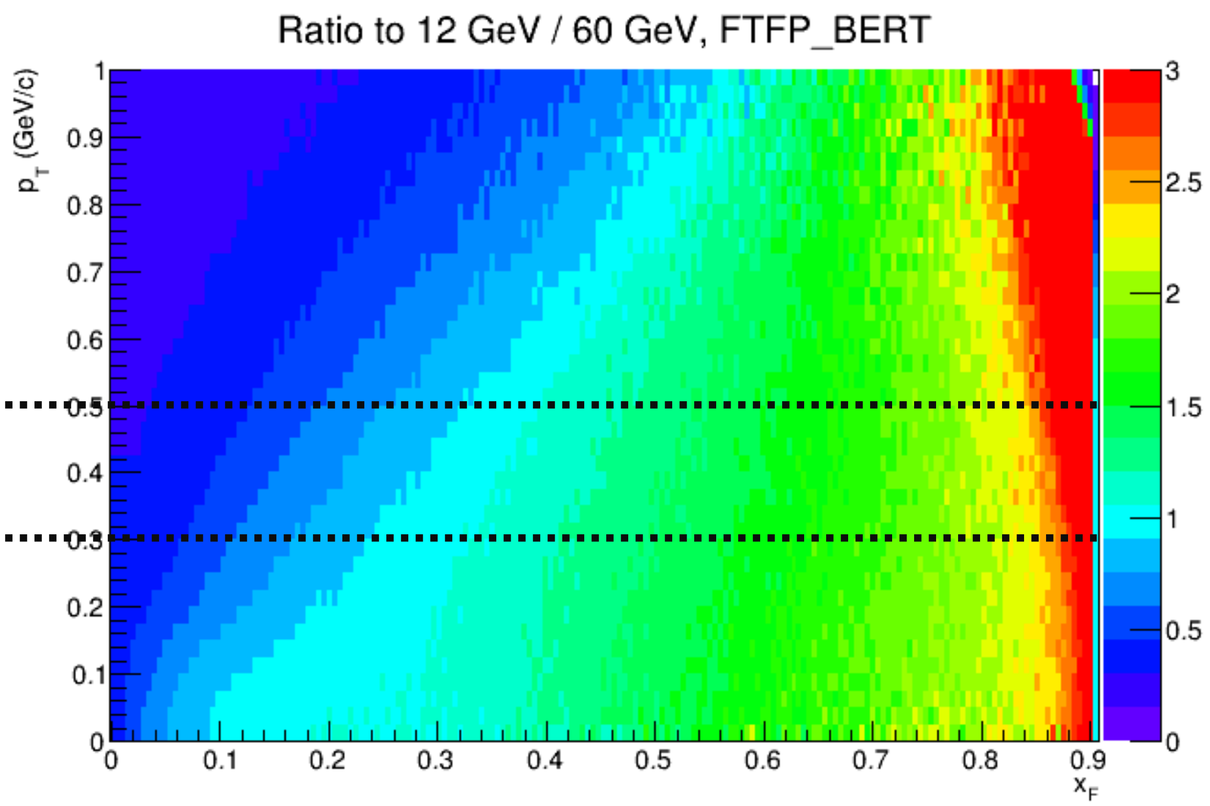
Even this is a crude approximation, we can see some patterns

1) Barton and NA61 seem close when they overlap.
2) The xf scaling violate when we compare HARP wrt NA61+Barton

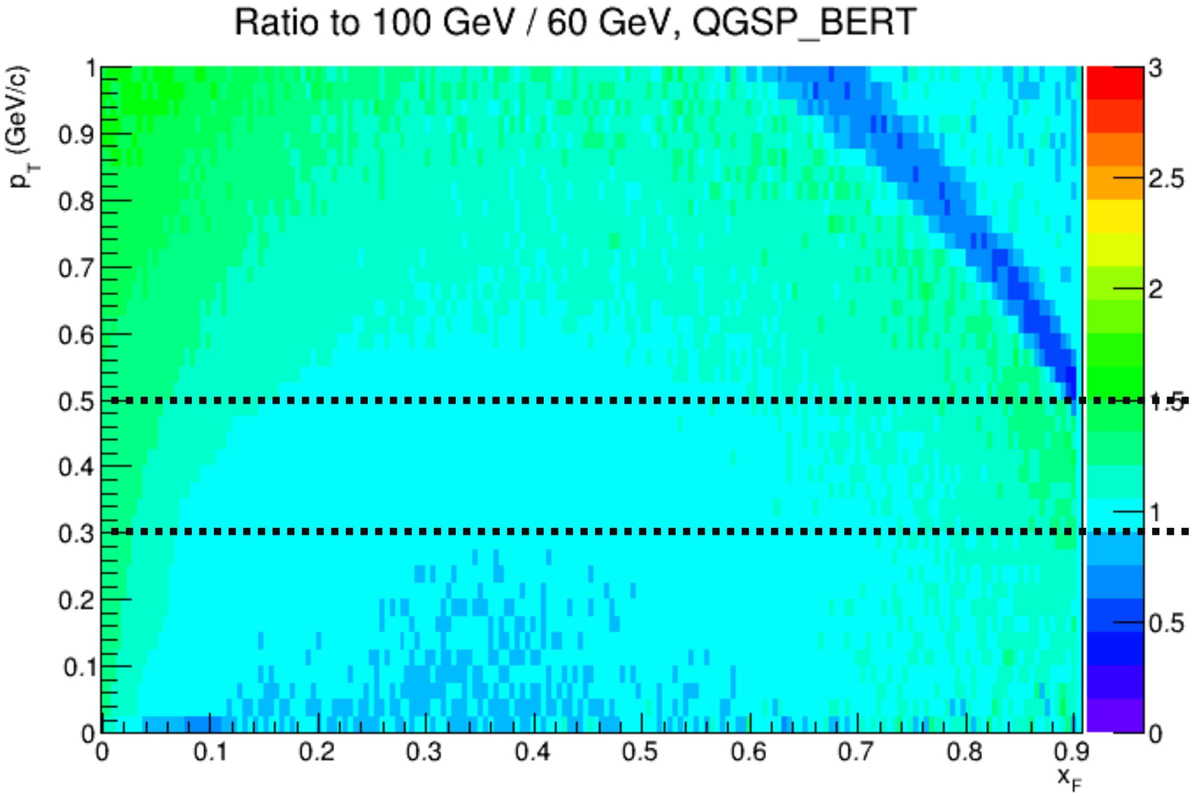


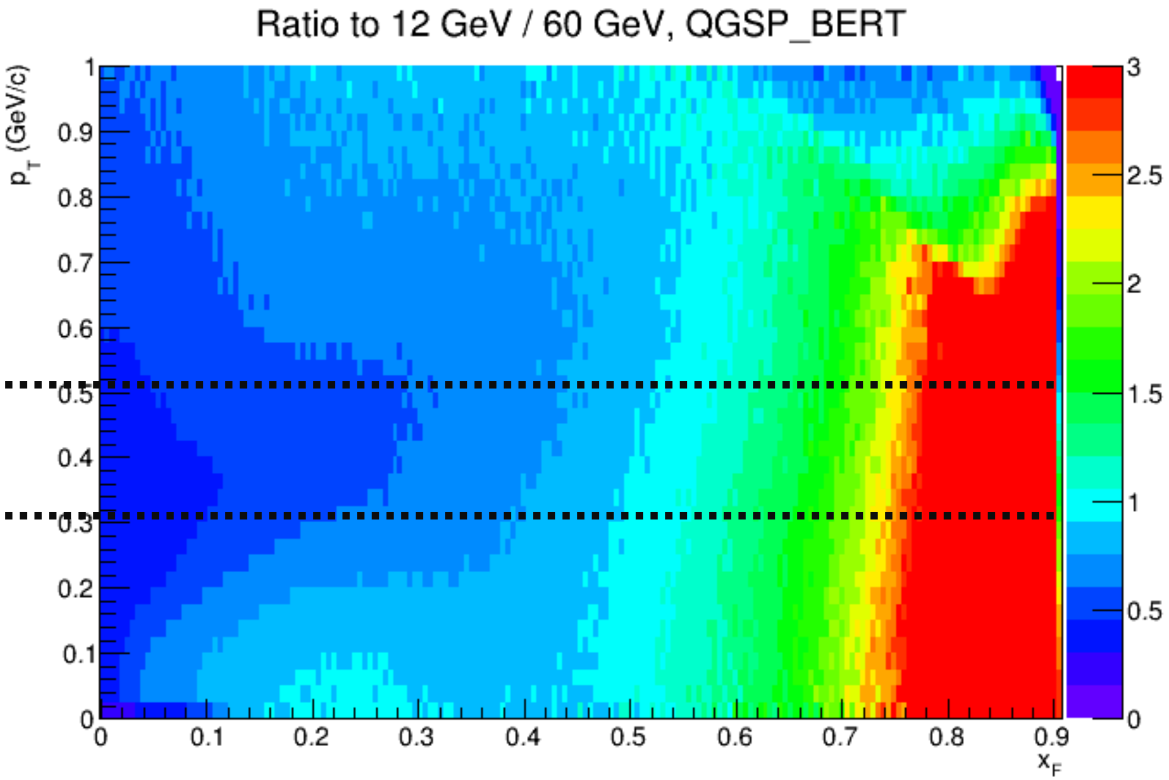
Invariant cross-section comparison by using FTFP_BERT





Invariant cross-section comparison by using QGSP_BERT





Conclusion

- This is my first attempt to compare HP data at different energies and evaluate Feynman-x scaling.

- There are more items to study:
  1) The impact of the bin size
  2) The uncertainties
  3) The detailed study of MC values

Any suggestion is welcome!